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Planning for Telecommunications: A School Leader's Primer

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Ministry of Education, Ontario
Information Services & Resources Unit,
13th Floor, Mowat Block, Queen's Park,
Toronto M7A 1L2

National School Board Association
1680 Duke Street
Alexandria, Virginia 22314

U S WEST Communications
Government and Education Services
121 S.W. Morrison, Suite 1500
Portland, Oregon 97204

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Acknowledgements

Research and writing: Karen Kitchen
Edina, MN

Contributing Writer: Dr. Ellen Wagner
University of Northern Colorado

NSBA Editor: Anne W. Ward
Alexandria, VA

Cover Design: Graphic Media, Inc.
Portland, OR

Layout and Coordination: Jon Erickson
U S WEST Communications

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Dear Educator:

Telecommunications is one of the most exciting technologies in educators' "tool kits" today. As it electronically links learners with instructional resources, it is helping rural school districts meet curriculum requirements and enabling all school districts to enrich their students' learning experiences.

The National School Boards Association is pleased to offer — together with U S WEST Communications — this practical primer on telecommunications. School leaders will find in these pages some thought-provoking advice on how to envision the future of education, plan for the purchase and implementation of equipment and ensure that curriculum needs are well-served by selected technology.

In a time when the job of educating America's children is becoming more challenging, school leaders should not overlook the potential benefits of technology in education. We hope that this book will help you make the most of technology as you strive to create more productive schools.

Very truly yours,

Leonard Rovins
NSBA President

Thomas A. Shannon
NSBA Executive Director

NSBA
LEADERSHIP FOR PUBLIC EDUCATION

NATIONAL SCHOOL BOARD ASSOCIATION
1680 Duke St., Alexandria, VA 22314
(703) 838-6722

There is a consensus that the appropriate assignment of new technologies within effectively organized schools could make a big difference in academic performance, motivation and dedication to learning. The broad experimentation of the last decade has generated a knowledge base for schools and policymakers. The Nation is now poised to decide on the next level of commitment.

POWER ON! New Tools for Teaching and Learning
Congress of the United States • Office of Technology Assessment

Given the reality of the budget constraints which face us, the immediate need in mathematics, science and foreign languages, and the long-term need to provide opportunity where it does not exist, the use of telecommunications in education may provide the answer.

Senator Edward M. Kennedy (D-MA),
in a statement to the U.S. Senate on the use of telecommunication
in education and in support of the "Star Schools" bill, March 11, 1987.

Each school district in the country has "master teachers." With a regional interactive distance learning system, districts can now share the expertise of those teachers effectively.

Two-way Interactive Television for Distance Learning: a Primer
Karen and Will Kitchen • NSBA Technology Leadership Network

Technological innovation, to be sustained and effective, cannot be treated simply as an "add-on" to the established curriculum and process of schooling.... Changes in technical systems - for instance, educational applications of computers, videodiscs, robots, cable and satellite communications, and software, as well as ... learning methodologies - are inextricably connected to the other major components of the schooling system: human resources, management, and organization.

Technology and Transformation of Schools
Lewis J. Perelman • NSBA Technology Leadership Network

Contents

Background 1
What is Technology?. 1
Is Technology anAnswer? 1
VISION 1
The Future of Education 3
The Curriculum 4
The Community 4
District Leadership 5
POLICY 5
ARCHITECTURE 8
Cost 10
Comparing Technologies 11
Combining Technologies 12
Conclusion 12
Glossary 13
Bibliography 14

Appendix A Instructional Design and Development: Contingency Management for Distance Education

Appendix B Feasibility Study for a Two-Way Interactive Television System

Appendix C Audiographic Conferencing in Small Rural Schools in New York State

Background

Education is typically more reactive than progressive, careful rather than creative, characterized by short-term solutions rather than long-term solutions. Curriculum, staff development, and professional standards are educational concerns that have suffered the ebb and flow of "new ideas."

New challenges for education are arising from society's change from provincial to global emphasis. This new emphasis marks the shift from an industrial economy to an information economy, from manufacture of goods to the creation and dissemination of information.

How does this change affect education? Recently several reports, most notably "A Nation at Risk: The Imperative for Education Reform" by the National Commission on Excellence in Education (April 1983), have delineated the problem – education is not meeting the challenge. Enhanced curriculum, better teachers, sharing of resources, and increased cooperation among schools are touted as answers to the problem. But the solution creates yet another question: How? In a word, the answer may be *technology*.

As state-mandated graduation requirements have increased, often in the areas of foreign language and science, enrollments and tax bases have decreased. This is not just a rural problem. While rural school districts are geographically isolated and do not have the financial ability to add teachers or courses, urban school districts are experiencing a large influx of non-English speaking students. Both rural and urban areas must find ways to share resources in order to survive and prosper. Technology offers new ways to share resources.

What is Technology?

Just a few years ago, "technology" was synonymous with "computer." The increased use of computers in the workplace created a ripple of panic throughout the education system. If students had to contend with computers in their careers, shouldn't they be exposed to the hardware and software in schools?

Computer labs proliferated. Basic programming was required for all students in some school districts. Tutorial, drill and practice programs for English, math, science, and foreign language littered the classrooms.

Software demands mushroomed at the same time research indicated that very few workers needed advanced training to run the hardware. And then, another discovery: the computer is a wonderful tool for repeating or retrieving information, but it cannot generate ideas or produce original information. Only people can do that.

Is Technology an Answer?

Yes, if school administrators and staff take a hint from the Greek origin of the word "technology"—*systematic approach.* Technology can

- enhance and expand curriculum choices
- encourage sharing of resources and expertise among school districts
- decrease duplication of low-incidence courses
- create more opportunities for staff development
- involve the community in life-long education

Through systematic approach, technology can be incorporated into an educational system; it can be an answer. This approach can be divided into three stages: **vision, policy, and architecture.** These stages serve as a guide for the process of planning for technology integration into an education system.

VISION

This is the beginning point. Administrators, school boards, and staff need to discuss how to expand educational opportunities. Some of the most common ways to accomplish this are to

- add teachers
- consolidate schools or classes
- increase class size
- raise tax levies
- share teachers
- encourage mentorship

Adding and sharing teachers creates both financial and transportation headaches. And, more importantly, oftentimes teachers in particular fields of study, such as science and foreign languages, are not readily available. Driving distances among school buildings within a cooperative can be time-consuming, a scheduling nightmare, and, in inclement weather, dangerous. Consolidation is a politically and socially difficult topic. Closing a school can mean the loss of identity for a small town as well as the problem of finding a use for the abandoned school building. Raising taxes might be a solution for wealthier school districts, but not for less economically-advantaged areas. Increasing class size is often a union-negotiated or state-mandated issue and is not a popular solution for teachers, students, or parents. Mentorships are an innovative way to provide an alternative learning experience if there are people within the community with the ability and time to undertake such an endeavor. Even then, there may be certification and accreditation problems if mentors do not have valid teaching certificates.

Some districts transport students to other districts, particularly for vocational-technical or advanced placement courses. This again is feasible only when distances and schedules allow. The state of Minnesota has instituted a Post-Secondary Educational Opportunities Program (PSEOP) that allows juniors in high school to take courses for both high school and post-secondary credit at any post-secondary institution. Another Minnesota innovation is the open enrollment policy. School districts have the choice of opening their enrollment to students from other districts. These are viable alternatives if the student lives near such an institution.

At best, these educational alternatives are only short-term solutions to long-term problems. They also do not address community or life-long learning issues. The question remains: What is the best way to expand the curriculum, considering fiscal and transportation restraints, educational feasibility and effectiveness, and resource availability and applicability? *The answer may still be technology.*

Using a systematic approach to planning, a technology system can allow school districts to

- share faculty
- share community and business resources
- expand and enrich educational opportunities for students, teachers, administrators, and community members

All these benefits are available without the worry of uncooperative weather, loss of community identity, or decrease of teacher or student productivity because of time spent traveling from place to place.

Before any technology-based system is considered, decision-makers must keep in mind: *the place to start is with education, **not** with technology.* Administrators, school board members, teachers, and community members must work together to create a realistic *education plan.* The strategy should be

- on-going and evolutionary
- long-term
- cooperative
- flexible
- educationally feasible and effective

The education plan will determine the type of technology. The delivery system should only affect the instructional strategies, not the education goals.

From the beginning, cooperation and communication are the keys to the creation of a successful education plan. This planning process is complex and encompasses

- assessment of needs and resources
- formulation of goals, objectives, and strategies
- initiative for information sessions and staff development
- implementation
- institutionalization
- evaluation

All these elements must be planned for in order for change to become a reality, not a fad. The change agents, in order to make this process work, need both a theory of education and a theory of change to integrate knowledge within the existing culture. Administrators can make changes happen, help them happen, or simply let

them happen. It often results in a costly disaster when changes are not anticipated while planning the integration of a technology system. The Utah State School Board set primary goals for attaining excellence in education that can serve as a model for planning—not just for the integration of technology specifically—but for improving school productivity in general. Elements of the 1984 plan include

- reforming curriculum
- enhancing teaching as a profession
- using physical resources
- involving parents and community in decision-making
- developing partnerships between communities
- assuring quality academic experiences
- emphasizing educational leadership and management
- providing services to students currently unserved or underserved

How are these elements related to technology? Technology provides the *means* to change, but only within the framework of what changes are needed. For example, if a school district wants to incorporate advanced placement courses in the curriculum, it should base the decision on the need to have those courses, not solely on the availability of these courses via a technology delivery system. The decision to have AP courses should be curricular-driven, not technology driven. If a school district perceives the need to develop more effective staff training programs, it should be a decision based on professional growth and increased effectiveness, not solely on the possibility of pooling and sharing training resources through technology. This is not to say that technology is ignored in the decision-making process, but that it should not be the central impetus of change.

While the Utah report emphasizes sharing of resources, community involvement, and curricular reforms for a broad range of students, an important component is *educational leadership and management.* Without leadership, the curriculum innovations may not be purposeful nor well-designed. A change agent—the leadership and management role—must recognize educational standards. If the curriculum changes are not well-planned, purposeful, and focused on desired learner outcomes, the changes will never become institutionalized, just as computers in schools often languish in labs because of lack of planned innovations for their incorporation into an education plan.

Besides clear-cut education goals, the education leader must encourage community involvement and commitment for long-term support and success. This is especially true if the delivery system for the innovations is to be technology.

The Future of Education

Part of the planning process can be shaped by asking questions about the future of education, not only for one school district in one community, but also for others in the state, the country, and the world. Some questions that can be used as guidelines for developing an education plan are:

1. What is happening to educational policy and reality (in areas such as funding, teacher education)?
   - Where are innovations occurring?
   - What are the trends?
   - Where are education in general and educational reform specifically heading?
   - What are the demands — both now and in the future — on the educational system? What is important for students to know in a global, information-based society?

2. For a small school, what makes the school special? How can the community preserve its uniqueness? How can the school meet the need for
   - innovative classes within fiscal restraints?
   - programs for underserved or unserved students?
   - state-mandated requirements?
   - equity with larger school districts?

3. For larger schools, the questions are the same, although school populations and their needs may differ from those of rural or small schools. Additional questions may be centered on how to provide
   - quality of education to all segments of the student population

- reduced duplication of services and classes within a school district
- incorporation of community and business/industry into education

4. Other questions explore what the superintendent, school board, teachers, and community want to offer their students.
   - What is the "culture" of the district? How is it maintained?
   - What are the successes of the past? The failures?
   - What is the educational reputation of the district within the state?
   - Is that reputation satisfactory or does it need to be changed?

5. The last question centers on what can be done to offer a better education to students and the community. If this can be accomplished through more and better opportunities, then how can decision-makers
   - improve coordination, cooperation, and responsiveness?
   - share resources with other communities?
   - gather and disseminate essential information quickly?
   - speed up decision-making?

Answering these questions can provide a framework for an educational plan that is responsive to the needs of a community. Sharing these ideas both ideologically and practically can increase cooperation among schools districts that might share a technology system to implement the educational plan. Coming to an agreement on these goals and objectives is essential before the discussion of technology even begins.

The Curriculum

What is happening to education? Just as the shift from an industrial society to an information society has affected the workforce and the economy, so has it affected education. Does this mean that students need to have *more* information? No, not necessarily. But it does mean that students need to be better prepared to access, synthesize, integrate, and use information resources.

Students need higher level thinking skills, including critical analysis and decision-making techniques. What courses enhance these skills? Typically, math and science. But, society is not demanding a nation of conventional mathematicians and scientists. There is now an emphasis on a more Renaissance approach to education. Medical and journalism post-secondary institutions, for example, are encouraging their students to take liberal arts courses to enhance abstract expression and creativity as well as the more concrete anatomy and law courses.

What courses foster expression and creative thought? Art, music, the humanities. In recent years, there has been a renewal of interest in foreign languages. The maxim "I buy in my language, but I sell in yours" is particularly true in the shrinking global marketplace. What courses help students learn to sell? Foreign languages, speech, and inter-personal communications. Can technology provide the means to offer learning opportunities in critical thinking skills, creative expression, and language? Yes.

The Community

Another factor to consider is what the community expects of its educational system. An agrarian-based community may have different educational and social concerns than an urban community. For example, a rural community might want an increase in extension services, small business seminars, and government program workshops. In one central Minnesota area, a seminar on stress management for farm families was offered over a telecommunications system. More urban schools might want an increase in programs for non-English speakers, literacy, and parenting. A high population of special needs students can influence services and program development. Several states are experimenting with using technology for student assessment.

There are also differences in community expectations based on financial stability. A wealthy school district might want to add advanced placement and college-level courses to its curriculum while a less affluent district might need to deliver state-

mandated or other required courses. Technology can deliver whatever courses are deemed necessary and desirable by the community, but only after the community has made its expectations known.

District Leadership

Educational expectations are linked to the school identity and culture. What courses — ideally — do the superintendent, school board, teachers, parents, and community want to see offered? By studying past successes and failures, decision-makers can fashion a customized curriculum to meet specific needs and expectations of the district.

District leadership is essential when school districts begin to explore the possibility of sharing human and technical resources. This exploration encompasses local businesses, industry, and community and goes beyond designing traditional high school classes. Lifelong learning, retraining, recertification, and enrichment are also part of the long-term educational plan. However, both traditional and non-traditional educational goals and objectives must be formulated before entering into a technology partnership with other school districts or with business.

Some of the questions that will help delineate and assess an educational plan include

- Is more better?
- Are there qualified teachers able to teach newly-created courses?
- What is the timeline for gathering and disseminating information?

Sometimes quantity is substituted for quality. Adding new courses should be valuable to the curriculum. Whereas the study of physics of sports or music theory or World War II or Japanese might be interesting academic electives, do they truly reflect the vision and culture of the community?

Another aspect of this assessment centers on the teachers. Are there qualified — and willing — teachers available to teach the new courses? Since teachers are an essential part of the planning process, this question can be answered early in the process. If a course is deemed necessary, provisions need to be made to obtain the services of a certified professional, perhaps from other school districts within the proposed technology cooperative or within the business community. Finally, a district leader's major job is to establish a timeline that clearly establishes

- when the information gathering begins
- who gathers the information and from what sources
- when and to whom the information is given
- when decisions are discussed and finalized

At first glance, this discussion and these questions have little to do with telecommunications in education. However, defining the vision is essential, particularly in the case of a technology-based application. That vision — stated as goals, objectives, and timelines — does not dictate the technology. The technology must adapt to the vision.

POLICY

The next step in the planning process for integrating technologies in instruction is establishing policy and procedures for the cooperative project. Where as vision is created for each individual school district, policy and procedure involves all members of the technology cooperative, including other school districts, education service agencies, and business partners. Some of the considerations in formulating policy are

- delineating responsibilities
- assuring accountability
- coordinating resources
- defining standards

Delineating responsibilities. It is important that all possible areas of difficulty or difference are explored. Obviously, one person cannot become knowledgeable about discipline, scheduling, teacher negotiations and assignments, calendar year, administrative issues, registration procedures, fair use, security, public relations, and course development — to name just a few of the areas that need attention. District leaders are challenged to find answers and make adjustments and compromises to help the process proceed smoothly and on time. These leaders can designate particular group representatives to wrestle with the intricacies of coor-

dinating school and transportation schedules, different class times, and various curriculum concerns. Instead of chaos, assigning areas of responsibility can result in rational choices, alternatives, and suggestions for discussion.

Assuring accountability. Technology is not free. Where the money comes from to support the technology infrastructure is important. Some projects are funded through seed money in grants awarded by state government. Others are funded through changes in levies at the community level. Still others form business/education partnerships where the cost is shared among the partners. In this relationship, the business and educational institutions also share the infrastructure. Besides the financial questions, a business/education partnership entails answers about responsibility for maintenance and upgrading. Whatever the means for funding, it is essential that either the sources engender a long-term commitment or additional funding is readily available.

Coordinating resources. This is a listing process. What does each participant in the technology cooperative have to offer? This can include teachers and their specialties, hardware and software (Are these compatible with other school districts?), technology equipment (such as a satellite dish, microwave tower, coaxial cable, or a radio broadcast station), community education personnel, outreach and extension courses, courier services, a special education cooperative, and transportation schedules and routes (particularly if school districts share busing for vocational-technical and special education programs). The more resources that can be shared, the less need for costly duplication. For example, if districts share a compatible computer system, data — such as tests, assignments, or administrative information — can be transmitted easily from school to school. If buses travel among school districts, they can be used to deliver written assignments from students to teachers in schools within the technology cooperative, instead of relying on overland or electronic mail.

Defining standards. Each school district has different standards, policies, and procedures. These differences make each district unique. However, when working with other school districts, district leaders must reach common ground on administrative, curriculum, and instructional concerns. In order for a cooperative to be successful, these standards—whether discipline, course requirements and registration, or expected learner outcomes – are part of the policy and procedure-making process. [See Appendix A]

Some more specific questions that can help determine policies are

- What timelines do the schools want for establishing changes in educational, technical, curricular, staffing, and community outreach activities?
- How is the infrastructure funded? At the federal, state, and/or community level? Are there any business/school partnerships involved?
- What future expansion and upgrading is planned?
- How are vendors selected for the project? Who establishes criteria for participation and monitors vendor activities?
- Who specifies, coordinates, maintains, and evaluates educational outcomes?
- Who is in charge of technical operation of the project, development of the curriculum, and staff training?

Policies in a technology-based educational project define the architecture, addressing the larger picture, not the operational details. Creating policy demands both imagination and realism. Policy also supports the idea of *"value first."*

The major pitfalls in designing policy involve details. Excessive attention to detail can doom a project, causing endless delays and confusion. Usually technical details crop up at the beginning of the planning process and bog down the proceedings before it is necessary to discuss them and when decision-makers do not have the knowledge necessary to make informed decisions. That is why the educational plan is the first step, policies the second, and architecture — the detail-oriented technology — the last.

Compounding the details is a foreign language, an argot of technical buzz words that is daunting even to the most intrepid decision-maker. For example, there are three main aspects of any telecommunications system: transmission, switching, and ter-

minals. The transmission links the signals sent between sites and codes the information, and can include fiber optics, coaxial cable, microwave, and satellite. The switches process transmitted signals. The terminals are the end-equipment where the transmission is received. This progression is quite straight forward until the conversation turns to types of telephone lines, analog versus digital transmission, Coder/Decoders (CODECs), speed of transmission, and so on.

At this stage in the planning, the particulars – the details – of the technologies are not important. The framework for the system is important. There are several criteria in this framework that are applicable to any telecommunications system:

- integration possibilities
- inter-connection with other networks
- sharing potential
- capability of expansion
- reliability and maintenance
- developing telecommunications standards

Investigating these questions and the answers will eventually impact on the choice of technology. If, for example, one of the criteria is expandability – so that more channels and thus more classes can be added in the future – then some technologies might not be considered. If interconnection with a post-secondary institution or private business is a goal and the selected group is already using a particular technology, building an entirely different technology infrastructure may be unwise. System reliability, low maintenance cost, assured accessibility, and cost containment are other factors that make some technologies more suitable than others.

In setting goals and objectives, decision-makers are asked to consider both present and future needs. The best telecommunications policies are concrete and specifically address concerns about changes made in curriculum, how staff will be inserviced and administratively supported in their use of the system, and what value-added features are possible and desired. Most ambiguity stems from technical, fiscal, and societal uncertainties.

Uncertainty can be minimized if

- the focus of objectives is education, not technology
- the emphasis in decision-making is on benefit, not cost

Decision-making can be a difficult process. The informed administrator initiates and nurtures the process by setting clear goals and objectives, listing priorities, guiding planning, setting timelines, and increasing educational awareness. The administrator's role can be greatly enhanced by a consultant and/or a representative from a telecommunications company – with a broad base of knowledge about both education and technology. The resource person should be practical, not theoretical, and experienced in the field. This external source of information and support can expand the opportunities for dialogue and stimulate ideas for developing a long-term perspective of education and technology.

Even with an expert in education and technology guiding policy-making, education is the driving force behind the technical planning. Defining the education goals within the framework of technology impacts on technology choices in the areas of

- long-term applications (expanding traditional and non-traditional curriculum *and* upgrading the technology system)
- policy (timetable for education plan *and* construction and implementation of the system)
- constraints (staffing, administrative, and fiscal; *and* technological, physical capabilities, and expansion/upgrading)
- design (capabilities, flexibilities, initial costs, and maintenance)
- operation (control and support of system *and* maintenance and reliability)

Policy, then, defines the parameters of the education plan, clarifies responsibilities, and sets self-imposed constraints. Nothing in this process happens by default or accident. Someone or some designated group is chosen to play a leadership role in planning, coordinating, and implementing the educational goals, policies, and architecture. Policy also forms a structure for providing information to everyone affected by the change.

However, policy is not only for specifying education goals and objectives. It is also a means for structuring decisions on the *selection of a vendor* – the company that will construct the telecommunications system – and selection of technology. For example, a policy regarding vendors can be relatively simple: only vendors with established reputations for service and support will be considered. This policy does not mention cost, but does allow schools to pick the most appropriate vendor for the job rather than just the cheapest. Sometimes a "bargain" in the beginning becomes a fiscal white elephant at the end. A reliable vendor can often anticipate problems before they happen or correct them efficiently when they do.

ARCHITECTURE

Decisions about the telecommunications project's architecture serve as a blueprint for planning a network that meets present and future needs in four major areas: *education, organization, technology, and finance.* These questions and concerns apply to any telecommunications system.

Education

- Can the education goals and objectives be met using this system?
- What needs to be done regarding training and integration of the idea into the "normal" school setting?
- How can technology application expand the outreach of the school to include the community?
- How can telecommunications add to lifelong learning opportunities?
- What other uses, besides traditional classes, can the system offer?

Organization

- What administrative changes must happen to increase successful incorporation of the technology system into the educational system?
- How can the staff be effectively and positively trained to use the system effectively?
- Who is responsible for the different aspects of operating the system? Does the school need to hire new staff or re-train existing personnel for management roles?

Technology

- What capabilities does the system have? One-way? Two-way? Three channels? Sixteen channels?
- What are the initial connection costs?
- Can the system be expanded or upgraded for the future?
- How does the system work? Does it work consistently?
- What can the system do? Data transmission? Video? Audio?
- What is the added value of the technology?

Finance

- How will the costs for constructing and maintaining the system be shared?
- Who is responsible for maintenance and repair?
- Is the system leased or owned outright by the schools?
- How are the upgrades paid for?
- Is there potential for a business partner?

The next step is reviewing the technology itself: the infrastructure, capability, and characteristics. There are four technologies that dominate the field of educational telecommunications: fiber optics, coaxial cable, microwave, and satellite. Each is capable of

- audio, video, and data transmission
- two-way interactivity
- expandability
- security

Two-way interaction refers to the ability of a system to send and receive video, audio, and data simultaneously. For example, Site A is considered the home school district. It can transmit an audio, video, and data signal to remote Site B and Site C at the same time that Sites B and C transmit back to A as well as to each other. In other words, the teacher and students in all sites can see and hear each other. In one-way interaction, only one site would be seen and heard and the other two sites only heard, usually via telephone.

Data transmission requires a system that can handle the speed of the transmission and that is compatible between sites. Some technologies cannot send data without some loss of fidelity to the original. That is, there are changes in the signal.

If fidelity is a policy prerequisite, some systems can be eliminated from consideration.

Expandability, or up-grading, refers to the system's capability to be added to or enhanced. If the long-term education goal designates a 12-channel system and the system can be expanded only to six channels, then the system does not meet the goal and can be rejected. Coaxial cable, for example, is not as expandable as fiber optics because cable companies usually will not expand beyond their original capacity. If a school district is tapping into an existing cable system, this might be a drawback. If working in a yet-to-be built cable system, future expansion might be negotiable.

Security is an unusual consideration, and in some areas is a politically-charged issue. Privacy of transmission has been a negotiation issue in teacher contracts in some school districts, forcing several districts to scramble the cable transmission—a costly procedure. Some technologies are more secure than others.

FIBER OPTICS the newest technology, consists of glass fibers the size of a human hair. Instead of electrical signals, light signals are transmitted through these glass fibers. Currently, telephone companies are switching over to this transmission technology when they need to expand or upgrade their infrastructure.

Characteristics of fiber optics include:

1. 24 channels per fiber (number of fibers unlimited)
2. Highly expandable
3. Audio and data transmission signals easily included
4. Extremely secure
5. High fidelity signal reproduction
6. 30-40 mile coverage area without a "repeater" or amplifier
7. Unaffected by weather
8. Not susceptible to interference and noise
9. Additional equipment: repeaters, modulators, demodulators, optical receivers, and transmitters
10. Life expectancy of equipment: 20 to 25 years

COAXIAL CABLE consists of a metal cable covered by a conductor that carries broadband television signals using high-frequency electromagnetic radiation.

Characteristics:

1. Limited number of channels (negotiated with cable company)
2. Limited expansion potential
3. Separate channel for data transmission
4. Relatively unaffected by weather
5. Available in many areas
6. 30-mile coverage area maximum (needs multiple amplifiers)
7. Additional equipment: modulator, demodulator, antenna, addressable converter
8. Any cable subscriber can watch transmission
9. Life expectancy of equipment: 10 years
10. High maintenance costs

Both fiber optics and coaxial cable are only available in certain areas. Telephone companies and cooperatives are expanding their infrastructures with fiber optics within their territories. Cable companies also establish territories. School districts can form business/educational partnerships. This helps both parties share costs and enhance fiber optic and coaxial cable infrastructures. However, before entering into negotiations, administrators should contact qualified legal counsel experienced in telecommunications school/business partnerships.

MICROWAVE technology uses high-frequency radio waves for transmission. Unlike fiber and cable, these signals are sent through the air.

Characteristics

1. Not easily expandable (limited channel frequency availability)
2. 30-mile coverage from point to point (depending on topography)
3. Relatively inexpensive
4. Secure
5. Equipment needed: towers, wave guides, dishes, transmitters, receivers, monitors
6. Life expectancy of equipment: 10 years
7. High maintenance costs
8. FCC license required

SATELLITE technology has been used for years by businesses to conduct teleconferences, seminars, and classes.

Characteristics:

1. Large coverage range (national and international)
2. Inexpensive to receive signal, expensive to originate signal
3. Hundreds of channels (receive-only)
4. Any satellite dish owner has access to signal (unless scrambled)
5. Equipment needed: downlink, uplink (if sending signals)
6. FCC license required for sending signals up to satellite
7. No local origin of programs without an uplink
8. Life expectancy of equipment: 10 years

Cost

The most difficult part of technology is its cost. However, if technology is the only alternative for implementing the education vision, the benefits outweigh fiscal concerns.

While fiscal constraints are a factor in deciding on the infrastructure, *there are no simple formulas to help estimate the cost of a technology system.* Each is unique — in design and cost. The final cost per district is determined by variables such as

- existing infrastructure
- business/education partnerships
- funding possibilities
- distance and topography
- leasing and ownership
- system maintenance

For example, if the school districts are wired by a cable company and channels are available for educational use, the costs might be fairly low. If a telephone company is building a fiber optic network, then the possibility of sharing costs or leasing channels could lower the amount schools have to pay. And several states now offer grants to plan and implement educational technology projects. The choice of either leasing or owning the network can also influence the final cost to schools.

Costs have been averaged for three of the two-way interactive technology options (fiber optic, coaxial cable, and microwave) using a two-site prototype example designed by Dennis Pellant, a telecommunications consultant for Tele-Systems Associates, Inc. However, these comparisons are applicable only under certain conditions:

- the two schools are seven miles apart
- the schools are linked by a paved highway with an available right-of-way
- FCC or State PUC rules and/or regulations are not considered
- prices are for *average* equipment and labor

These averaged costs depend on the technology, added options, lease or purchase arrangements, and maintenance agreements. Again, *these estimates are for demonstration purposes only.* Actual costs will differ according to the project. It is recommended that school districts talk with a reputable consultant and/or telecommunications company about the cost of the technology options.

Fiber Optics. Materials are one pair of buried, single-mode fiber equipment for one channel of full video transmitted from each site with standard classroom studio equipment.

- Maintenance = one percent per year of system cost (average)
- Expandable to 16 channels at $10,000 per channel (duplex)
- Life span = 20 to 25 years
- Expandable to 200+ miles

Coaxial Cable. Materials include seven miles of .750 cable placed overhead on existing utility poles, spacing amplifier to use only VHF channels and sub-split returns.

- Maintenance = five percent a year of system cost (average)
- Expansion to four channels at $3,000 each (duplex)
- Life span = 10 to 15 years
- Expandable to 30 miles

Microwave. Materials include 4-foot antennas, receiving cable, one channel transmitter and receiver, and short "stub" towers. Signals are <u>not</u> modulated.

- Maintenance = three to five percent per year of system cost (average)

- Expansion to three channels at $15,000 per channel (duplex)
- Expansion depends on numerous technical factors

The last phase of planning centers on decisions about technology, the ARCHITECTURE. The chart below offers a capsulization of comparisons of the technologies with the highest potential for two-way interactivity in terms of cost, expansion, maintenance, special difficulties, and transmission abilities.

Comparing Technologies

	Coaxial Cable	Microwave	Analog Fiber*	Digital Fiber*
Cost	Medium	Low	Medium	High
Expansion Potential: Channels	Low	Low	High	High
Maintenance Costs	High	Medium	Low	Low
Special Concerns / Difficulties	Partnerships difficult to develop	FCC licenses difficult to obtain because of frequency congestion in urban areas		
Expansion Potential: Sites	Low-Medium	Low-Medium	High	High
Voice, Video, Data Potential	Medium	Medium	High	High

* Voice, data, and/or video signals can be transmitted over fiber optics using *digital* or *analog* techniques. The decision to use analog or digital fiber optics needs to be made with the following considerations: distance, future technologies, and integration with existing telephone networks.

Combining Technologies

As mentioned before, all interactive technology can transmit data. This allows for combining technologies, usually computers, resulting in networks that send and receive not only audio and video signals but also data transmissions. Some of the "add-on" technologies include

- LANs (Local Area Networks) that connect common data sources and programs. Educational networking software is available.
- MODEMs that link computers through telephone lines and provide access to databases, news, public information, and financial reports.
- AUDIOGRAPHIC systems that use telephone lines and a desktop telewriter computer to transmitgraphics to all computers linked on the system. [See Appendix C]
- CD-ROM (Compact Disc-Read Only Memory) has a 500 megabyte storage capacity. This storage mechanism, plus other innovations such as a videotrax that can store data on a videocasette, the interactive videodisc, and other optical storage media can enhance instruction and training.
- COMPUTER/VIDEO CONVERGENCE prototypes blend computer technology with laser optical storage technology to run programs that present limited-resolution, full-motion color video on a computer screen (digital video interactive) or combine still photographs, audio, and data (compact disc interactive).

It is important to remember that technology is only a tool that can help administrators, school board members, and staff improve their educational system if the planning and implementation is done thoughtfully and realistically. Educational leaders need to:

1. Know what is to be accomplished
2. Select a system that meets present and future needs
3. Prepare teachers and students to work on and with the technology
4. Establish an on-going system of instructional and technological evaluation

Conclusion

Planning for technology takes time, perseverance, and organization. There is nothing magic or mystical about technology; it is a means to an end — a carefully constructed vision of educational opportunities for students and the community.

The VISION encompasses

- education goals and objectives
- alternatives for meeting the education plan
- assessments of resources that can be shared

The POLICY phase of planning includes

- defining the education leadership role
- assigning responsibilities
- coordinating groups and resources
- gathering and disseminating information
- establishing timelines

While this primer might does not answer all the questions that will be generated by administrators, school board members, teachers, students, parents, and other community members, it can act as a guide for planning how to make decisions about technology that will serve the education goals and objectives for the present and for the future as well.

Glossary

Addressable: A system that allows communications signals to be switched on and off.

Amplifier: a device that boosts the strength of an electronic signal.

Analog transmission: the transport of data in a continously variable signal that resembles a wave pattern. The data can be differentiated by varying the amplitude of the wave or the frequency of the wave.

Channel: a communications pathway that carries one signal.

Channel capacity: the maximum number of channels that can be carried.

CODEC: a device that COdes/DECodes an analog video signal into a digital format for transport. A CODEC is required at both ends of the transmission.

Digital transmission: the transport of data in the form of discrete binary, on and off, electrical or optical signals.

Downlink: an earth station (dish) that receives a satellite signal.

Full duplex: channel over which it is possible to transmit and receive signals in two directions simultaneously.

Interaction: paticipation among viewers. In one-way interaction, the viewer in another site can see and hear the presenter, but the presenter can only hear the viewer. In two-way interaction, viewers and presenter can see and hear each other simultaneously.

Interconnect: linking several electronic sites to share programs simultaneously.

Modular/demodulator: devices that vary the amplitude, frequency, or phase of a signal.

Uplink: an earth station that transmits a signal to a satellite.

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Appendix A

Instructional Design and Development: Contingency Management for Distance Education

Ellen D. Wagner
University of Northern Colorado

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Abstract

This paper presents a review and analysis of the research and scholarly publication regarding the practices encompassed within the discipline of Instructional Design and Development (including its subsets of curriculum design, course design, program design). The use of instructional design methodologies within the context of Distance Education is described as an approach toward contingency management. As a component of this review, a discussion of the research into selected aspects of the processes of deciding what is to be taught, to whom, in what ways, and how media are employed is undertaken. On the basis of this discussion, recommendations for future research are made.

> "We have already discovered the futility of changing our goals as often as we change our technologies."
>
> Marshall McLuhan, 1964, xi

> "The challenge confronting education and educators is not to produce more electronic technology, but rather to develop creatively the educational potential that the current new technologies offer."
>
> Richard Braddock,
> cited by Gabriel Ofiesh, 1986, P.301.

Evans' (1979) prediction that the microprocessor's ability to access information would have as great an impact upon our future as had the printing press several centuries before has been notably evident in the realm of education. The proliferation of information technologies have dramatically altered the resource base upon which all educators depend. Data compilation, data manipulation and the interpretation of data enabled through human and/or machine intervention has resulted in previously unimaginable arrays of information, ready to be accessed and made meaningful by those technologically and cognitively proficient enough to do so.

Perhaps the most overt manifestation of this increasing interest in improving technological and cognitive proficiencies can be found among the recent calls for educational reform in this country. (Carnegie Foundation, 1986). While the ongoing American educational reform movement is not solely based upon the need to adapt to changes wrought by technology, there are several technology-impacted attributes of American society which have already altered the context within which future educational planning must occur:

> **Future educational endeavors will be increasingly more knowledge based.** In the Industrial ("pre PC") era, tasks were relatively simple; attitudes such as reliability, dependability and attentiveness were perhaps more important than intelligence or skill. But in the "Information Age," it is necessary to think

critically to sift through almost unlimited amounts of data and use them in meaningful ways. Educators at all levels of instruction, in all locations, must provide and be provided with the means through which critical thinking can be engendered both for themselves and for their students (McMeen, 1986).

There will continue to be an increased flow of information. Tetenbaum and Mulkeen (1986) have suggested that scientific and technological knowledge alone doubles every 5.5 years. It is necessary to harness that information and provide strategies through which it can be accessed, assimilated, synthesized and utilized. Educators will no longer be "teachers" so much as the facilitators of learning.

Rapid change and impermanence will be the rule rather than the exception. The speed of societal change will continue to accelerate. Jobs will change dramatically every five to ten years. No longer will individuals be able to go to school, graduate and consider their education complete, nor will they be able to enter a job or profession and expect it to remain the same. Continuing education and training will become the expectation rather than the exception.

Inter-institutional partnerships and resource sharing will provide partial solution to resource accessibility. Large, autonomous organizations are not able to adapt to the continual change that lies ahead. Problems will be more easily solved by means of people talking with one another within and among institutions. There will be an increase in partnering and collaboration, sharing perspectives and expertise, resource exchanges and mutually advantageous sponsorships of educational endeavors.

It is with the accommodation of these and other information-specific contingencies in mind that at least two academic disciplines have leapt to the forefront of educational practitioner circles. One such discipline is that of Educational Technology and its related area of emphasis, Instructional Design and Development. Another emerging discipline is that of Distance Education. The relationship which exists between these evolving disciplines may be more easily discerned by first considering the unique attributes of each; reviewing research germane to each discipline to look for complementary attributes, and then to consider ways in which one can make use of both disciplines to attain the goals of improved information access and heightened technological proficiency.

The Product and Process Components of Educational Technology

As educators have searched for ways to accommodate demands for enhanced accountability, teaching excellence and for "subject specialist teachers," the term *educational technology* has emerged at the forefront of contemporary educational jargon. It seems to employ that one can "fight fire with fire," solving technologically based problems with technologically based solutions. What educational technology provides is a conceptual framework within which *product concerns* (dealing with tangible issues related to instructional hardware and software systems) and *process concerns* (dealing with less tangible issues related to program planning, problem analysis, and the evaluation of instructional efficacy) can be concurrently addressed (Wagner, 1986).

The direct, immediate applicability of hardware/software dependent proficiencies has inadvertently promoted the emphasis of product-directed instructional planning at the expense of process-directed instructional planning (Wagner & Wishon, 1987). While the need to elicit a particular outcome should logically drive the selection and utilization of specific hardware/software interventions, this is not generally the case. Instead, decisions are more frequently driven by the interest/need/desire/demand for making use of a particular medium of transmission which may currently be in vogue, whether or not it is the medium most likely to elicit a specified, desired response. It is with the promotion of process concerns of educational technology in mind that the related discipline of Instructional Design and Development has evolved.

The Methodologies of Instructional Design and Development

Instructional Design and Development is an approach toward solving human performance problems. It encompasses an array of methodologies which can be used for tailoring performance improvement prescriptions (themselves derived from learning theory and instructional theory) to conform to situationally specific instructional constraints (Wagner & Reddy, 1987). More specifically, the discipline of Instructional Design and Development includes but is not limited to such activities as goal assessment (Mager, 1972); needs assessment (Rossett, 1987); audience/cost/concept/job/performance/task analysis (Merrill, 1980); instructional strategy development (Romiszowski, 1981; Gropper, 1974); instructional sequencing (Van Patten, Chao & Reigeluth, 1986); instructional delivery system selection, design and implementation (Clark, 1983); media production and utilization (Heinich, Molenda & Russell, 1985); formative evaluation, field testing and summative evaluation. Curriculum design, course design and program design exist as context-specific subsets within the broader, inclusive parameters of instructional design and development (Romiszowski, 1981).

Selective methodological adaptation to accommodate context specific demands has been described as a *systems approach* (Banathy, 1968; Gagne, Briggs, 1978; Gagne, Briggs & Wager, 1988). Stated more explicitly, the systems approach embodied in instructional design and developmental endeavors is essentially a goal oriented process involving interactive and interdependent activities from a variety of disciplines that are coordinated to bring about specified outcomes (Hymel, 1984). The relationships which exist among the components of such a system constitute replicable parameters within any given realm of instruction. The methodologies associated with instructional design and development allow a developer to determine whether or not a need for a new product exists; the level at which product design activities should be undertaken; the appropriateness of performance objectives; the efficacy with which new products have been integrated, implemented and/or utilized; and whether or not the identified problem is one that can be solved by means of instructional development (Wagner, 1986).

The Dick & Carey Model of Instructional Design

The utility of instructional design and development methodology can be more easily discerned by means of a brief examination of general instructional design heuristics such as those provided by Dick and Carey in their conceptual model of the instructional design process (1979, 1985). For novice designers, an instructional design model tends to function almost as a checklist, leading some writers to dismiss their use as "cookbooky" (Glaser, 1976). As a designer's skills and strategies become more expert, however, these stages serve as "rules of thumb" which represent general classes of activities to be addressed during the design process. In either case, models appear to be most useful in their ability to identify general varieties of activities to be considered rather than to provide concrete specification of steps to be undertaken.

Dick & Carey (1985) have suggested that when one undertakes an instructional design endeavor, one should do so having already undertaken an empirical determination of the actual problem to be solved or the need to be met. At that point, the instructional design process can proceed, and will tend to include the following "rules of thumb":

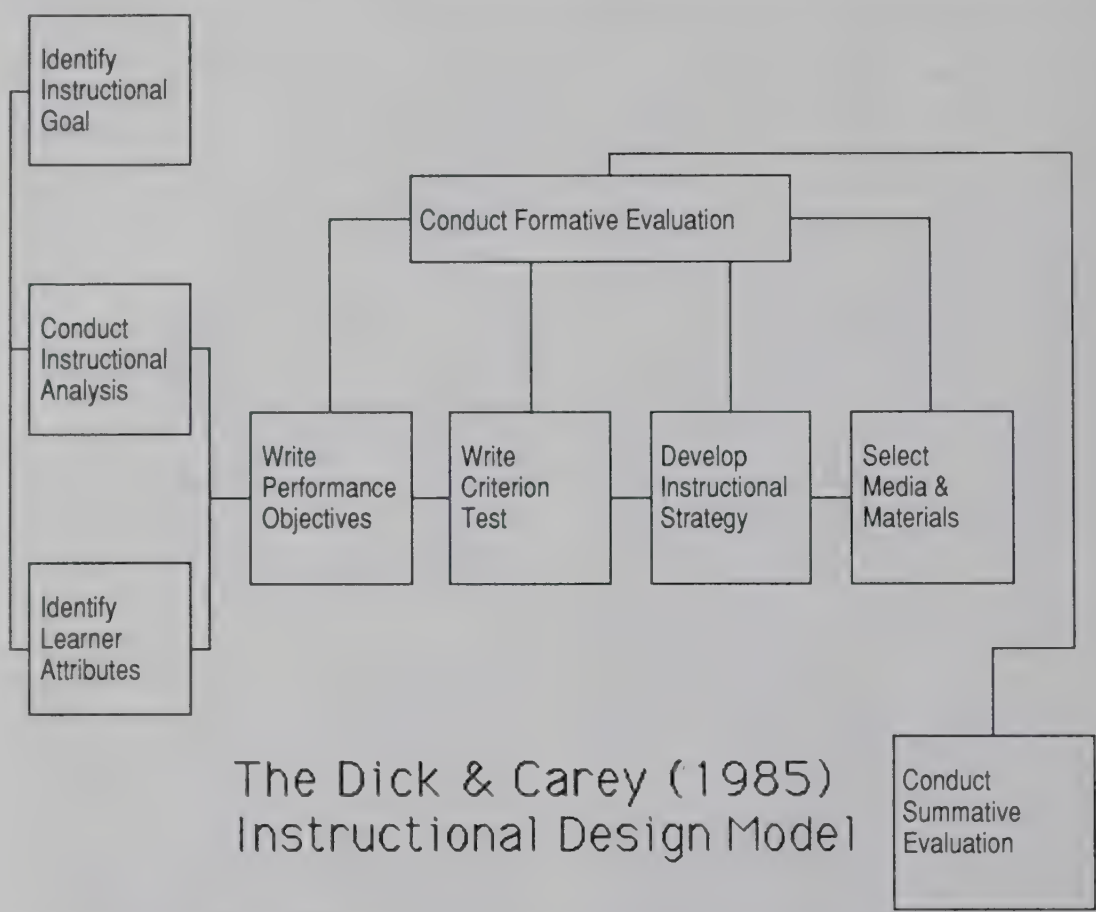
Determine the Instructional Goal - Determine what it is that the instruction is supposed to accomplish. In general terms one should be able to identify the performance deficiency which is to be alleviated by means of the treatment to be prescribed.

Perform a Learner Analysis - Consider the audience for whom the instruction is intended. Audience variables which will affect visual literacy include: cultural background, age, field of experience, motivation, and gender.

Perform an Instructional Analysis - Determine how (and if) instruction is likely to reduce a performance deficiency or if it is likely to result in performance improvement. Determine prerequisite skills needed to successfully undertake the anticipated instruction.

Develop Performance Objectives - Determine the target performance to be elicited, the conditions under which it is to be accomplished and the level of performance proficiency.

Develop a Criterion Referenced Performance Assessment Test. Determine the criterial attributes of a proficient performance and embed those attributes within an assessment exercise.



The Dick & Carey (1985) Instructional Design Model

Select Instructional Strategies - Determine the techniques and methodologies through which the instructional prescriptions will be administered.

Select Instructional Media/materials - Develop the instructional delivery system needed to transmit the information needed to bring about a change in the targeted performance.

Perform a Formative Evaluation - Determine the efficacy of the analyses, the design and the media; suggest revisions where appropriate.

Revise as needed, as per recommendations coming from the Formative Evaluation.

Conduct a Summative Evaluation - Prepare an "end of project" report in which the strengths as well as the weaknesses of the design are summarized; recommendations for future designs may be proposed as a function of the summative evaluation.

Media Selection as a Component of the Design Process

In reviewing the Dick and Carey Model, it is worth noting that the stage specifying the selection of media for use in a particular instructional design comes well after a designer has dealt with issues related to the instruction itself, the audience for whom the instruction is intended, the desired performance to be elicited, the determination of means through which performance will be assessed, and the determination of an instructional strategy appropriate to elicit the desired response(s). Reiser & Gagne (1983) have suggested that media should not be selected until specific events that will take place during an instructional sequence have been identified. Nevertheless, Reiser (1981) also found that only about 50% of the designers he surveyed used a systematic process for selecting instructional media. Clark & Angert (1981) suggested that those designers who do use a systematic approach toward media selection make use of systems which "reflect a preoccupation with technical considerations (e.g., convenience, portability) and are relatively short on instructional design considerations." (p.13).

It would be inappropriate to suggest that there is no need to be concerned about technical considerations when media selection decisions are being made. Nevertheless, it is also irresponsible to use such considerations as the primary force driving media selection decisions since they may not bear any relationship to the information transmission demands of a particular instructional situation. It is far more desirable to make selection decisions based upon the relative effectiveness of a medium or media to transmit critical information in such a way to maximize learning *and* instructional efficacy. Ironically, most studies undertaken to empirically determine the relative effectiveness of one medium over another have found that students may very well learn as well from one medium as from the other. (Chu & Schramm, 1967; Clark, 1983). While some authors (e.g. Wagner & Wishon, 1987) have suggested that the lack of significant difference may arise from an inability to generalize from experimental to applied investigations due to external validity problems with some comparative experimental and quasi-experimental studies, others suggest that perhaps the media do not really differ significantly in their ability to transmit information (Reiser & Gagne, 1983). Schramm's (1977) reflections upon this phenomenon included the following observations:

> "During the last few decades we have frittered away an enormous amount of research time asking relatively useless questions about the media of instruction. *Can media teach?* has been asked over and over again, and over and over again the answer has come back: of course, students can learn effectively from the media, from any medium. *Can they teach as well as a teacher?* The answer: what they can do, they can do as well as a classroom teacher, sometimes better. It depends upon the performance of the teacher, the content of the media, what is being taught, and to whom. *Is any one medium more effective than others?* For some purposes, probably yes, but overall there is no superlative medium of instruction, any more than there is one simple algorithm for selecting one medium over others. We have come to realize in recent decades that learning from the media is not an area that lends itself to simple answers. It is an extremely complex multivariate process that challenges us, if we are to understand it, not to ask simple questions, but rather to concern ourselves with the conditions for selecting one medium over another, for combining and for using media." (p.14.)

Preliminary findings by Wagner (1988) have indicated that media effectiveness may be maximized if selection decisions are made with the following factors in mind:

1. Media selections should be *learner focused*, where media have been selected to meet the information transmission/reception needs, interests and capabilities of its target audience;
2. Media selection should be *instructor directed*, where media have been selected to meet the information transmission/reception needs, interests and capabilities of the teacher who must select the instructional delivery system components;
3. Media selection should be *instruction centered*, whereby the probability of eliciting the intended instructional outcomes by means of specific media are maximized;
4. Media selection should be *design driven*, where situational constraints of financial, human and equipment resources, time, and other similar variables are viewed as contingencies to be managed in part by means of the media selection process itself.

A Look at Distance Education

Just as Instructional Design and Development have emerged to codify the multidisciplinary methodologies through which human performance improvement strategies may be developed, Distance Education has emerged as a situationally specific arena within which these methodologies may be utilized. Distance Education refers to the transmission of educational or instructional programming to geographically dispersed individuals and groups. More specifically, Keegan (1986) suggested that distance education encompasses educational or instructional programming which exhibit the following attributes:

- There is limited regular contact between instructor and student(s);
- The development and delivery of instruction as well as student support services are administered by a centralized educational agency;
- Various media (print, audio, video or computer) be used to transmit course content;
- There is some provision for two-way communication in the educational/instructional process;
- People tend to receive instruction individually rather than in (a) group(s).

Distance Education has evolved in large part as a response to specific demands for improving information access equity, with particular attention paid to the improvement of instructional resource proximity via technology. In very general terms, Distance Educators attempt to accomplish this end by means of promoting efficient, meaningful use of information transmission/reception systems. Consequently, one of Distance Education's most visible attributes is its emphasis upon media utilization as a means through which its ends are accomplished. Contemporary distance educational media utilization tends to highlight telecommunication technologies such as audioconferencing, audiographic teleconferencing, facsimile transmission, video teleconferencing via satellite or land line transmission systems as well as computer teleconferencing, local area networks or electronic mail. However, distance education practitioners are also likely to make use of message transmission/reception systems which make use of more traditional media such as workbooks, audiotapes, slide tape programming, videotapes, broadcast television programming, radio, and instructor led instruction. (Lewis & Markwood, 1985)

The *idea* of using high tech media such as satellite or land line audio, audiographic, and/or video teleconferencing, computing networks or data transfer systems as a media of instructional delivery appears to be highly attractive for use in business (Tyson, 1986) for college and university faculty and administrators, (Seamon, 1987) and for K-12 applications (CETC, 1988). Some reports have gone so far as to suggest that there is no longer any need to conduct pilot or demonstration projects to determine the feasibility of making use of telecommunications technologies for K-12 applications, since their value should be readily apparent (CETC, 1988). However, the attractiveness of such systems does not appear to have translated into actual

practice. A series of Western Interstate Commission for Higher Education (WICHE) surveys of public and private post-secondary schools compiled by Lewis & Markwood (1985) in its 13 member state (with 344 of 575 institutions responding to the survey) identified the following utilization patterns with regard to video, audio and computer technologies:

1. Videoconferencing: one-way video, two-way audio conferencing was being used by 9% of the respondents for on-campus instruction, 3% for off-campus instruction. Less than 7% surveyed make use of interactive cable systems, point-point microwave, videotext or two-way video teleconferencing.

2. Audioconferencing: Telephone technologies were used by 17% of the respondents on-campus, 10% off campus.

3. 71% of the institutions surveyed used computer assisted instruction on campus; 12% used CAI for off-campus instruction.

4. Multi-modal formats: 17% of the survey respondents use combinations of technologies such as audioconferencing, computers, video cassettes, broadcast TV or one-way cable television programming.

A national survey of educational uses of telecommunications technologies (Riccobono, 1986) indicated that the most widespread use of video and audio among all types of higher educational institutions was one-way presentation to on-campus students. Eighty-four percent of the institutions surveyed made use of video materials, while 75% made use of audiotaped materials. Only 26% of the respondents made use of relatively new modes of video technology such as computer-interfaced videodisks or videotape. In terms of live, interactive use of audio, only about 10% of the survey respondents made use of audioconferencing for instructional delivery. Riccobono suggested that the use of electronic/optical systems appeared to be much more prevalent for on campus than for off-campus use. Interestingly, in both the Riccobono (1986) and the Lewis and Markwood (1985) studies, primary emphasis was placed upon concerns for hardware systems than upon programming to be delivered by means of the technologies.

One recent study examining faculty attitudes toward the use of instructional technologies for on and off-campus instructional delivery revealed a variety of concerns regarding the feasibility of using such systems for outcome specific, instructional applications (Fox, Steffan & Wagner, 1987). Generally speaking, these concerns appeared to fall into two categories:

Product concerns included but were not limited to issues relative to the types of equipment which are required to deliver distant instruction; the types of technical support which will be needed to keep the delivery systems operational; central and site physical plant requirements (e.g. on and off campus); selecting adjunctive media hardware and software to be used in conjunction with distant instructional delivery.

Process concerns considered the selection of appropriate varieties of media as a function of the types of learning/performance to be elicited by the instruction delivered both via distant delivery and via on-campus technology utilization; in other words, analysis (whether it be job analysis, task analysis, learning analysis, instructional analysis, cost-worth analysis, audience analysis, situational analysis and so on) must be conducted to define the parameters within which one must operate. Process concern also focused upon the design of instruction specifically for distant delivery, the re-design of existing instruction to deal with the constraints of distant delivery, and the integration of media within an instructional delivery system which has been developed to maximize learning/performance outcomes. Finally, process concerns provide for the evaluation of instructional efficacy.

A review of the literature dealing with product and process research in distance education was undertaken to determine: (a) the degree to which empirical investigations have been undertaken to establish a foundation upon which to build valid, reliable, design-based models for distance educational endeavors; and (b) whether or not there is a discernable difference in the numbers of product and process investigations.

This review revealed a preponderance of product based studies. Process research tended to be far less context specific than did product research; investigators used distance education as a context within which design efficacy could be examined rather than as the primary focus of the investigation itself.

A Selected Summary of the Literature in Distance Education

Upon a general perusal of distance educational literature, four features were readily apparent: (1) Much of the literature exists in the form of occasional papers or as conference presentations/papers; (2) Most distance education literature tends to be conceptual in its orientation, providing direction for action rather than establishing broad, theoretical constructs; (Shaw & Taylor, 1984; Bates, 1985; Coldeway, 1987; Moore, 1987); (3) Distance education research tends to be descriptive in nature, presenting the results of observational data, case study summaries or of survey research (Stoane, 1985: Brown, et al, 1982; Grundin, 1983); (4) Distance educational literature is far more international than national in its orientation. Most of the distance educational literature describing applications of distance educational methods come from Great Britain (Sharples, 1982; Rogers, 1983, 1984) Australia, (Johnson, 1986; Bynner, 1986) New Zealand (Bates, 1984), Canada (Winn et al, 1985; Croft, 1986; Moore, 1985; Baggaley & Sharp, 1979), and Latin America (Chadwick, 1986). Publications from the United States have tended to deal with possibilities rather than with programming (Simonson, 1986; Locatis, 1987) although there have been occasional exceptions to this observation (Huffman, 1984).

The preponderance of investigations examining the impacts of a wide variety of media in distance educational endeavors support the notion that products rather than processes "drive" distance education. In this respect, distance education currently resembles developments in the field of educational technology (and its precedent fields of audio/visual education and educational media), where product based research was clearly more evident than was process research. Process investigations may be among the least credible research endeavors in educational technology since influential variables are not directly manipulated, controlled or eliminated; it is also much easier to measure the effect of an end product than it is to measure the efficacy of the means selected to attain that end (Wagner, 1986). Nevertheless, a rationale to encourage empirical research in process arenas of both distance education and educational technology may be simply stated: Less efficient planning is likely to yield less efficient products, whereas more efficient planning is likely to yield more efficient, cost effective products. Wagner has suggested that "the rapidity with which technological products are rendered obsolete suggests that future research in educational technology should establish a foundation for generalizing planning strategy development to complement the already established tradition of empirical product investigation" (p. 39). Just as educational technologists are beginning to make greater use of process methodologies, distance educators may find their interests to be well served by making use of instructional design and development to establish the framework for problem solving strategy development.

Instructional Design for Contingency Management

From this perspective, it is clear that instructional design and development functions as an approach toward contingency management. Distance education presents an instructional designer with a set of attributes which (a) serve to categorize distance education as a discernable, unique entity; (b) define the functional parameters within which a designer can begin to construct strategies to contend with discipline-specific as well as situationally specific variables associated with distance educational endeavors. Within this context, then, these attributes may be perceived as contingencies which will impact generalized problem solving "rules of thumb". Having defined one's operational parameters in terms of situationally specific contingencies, it is far easier to concern oneself with product issues which have direct applicability to the problem solving arena within which one is working.

Recommendations for Future Research

If one accepts the premise that distance education is a specific context within which instructional design methodologies may be used, then it is logical that future investigations dealing with instructional design for distance education need to examine facets of the design process which both precede and follow media selection activities as described in the Dick & Carey Model. It may be necessary to refer to basic research dealing with learner capabilities so that performance improvement prescriptions may be specifically tailored to build upon and expand existing competencies. Similarly, personological variables such as age and gender may need to be examined within the context of distance education to see if there are situationally specific contingencies which need to be accommodated. Instructional theory (Reigeluth & Stein, 1983; Salisbury, Richard & Klein, 1985) may provide the foundation upon which instructional sequencing may be undertaken more effectively, while a better understanding of metacognition's potential influence upon learning strategy development may impact instruction design endeavors (Schmitt & Newby, 1986), while imaginal information transmission factors affected by visual literacy, such as computer screen design, land line graphics transmission, and picture selection for use in slide/tape, videotape, video teleconferencing, videodisk and CD-ROM systems (Wagner, 1988) may affect the types of delivery system selection decisions to accommodate dual channel information processing capabilities (Paivio, 1979).

Summary

Throughout the 1970s and into the 1980s, the logarithmic proliferation of information technologies dramatically altered the resource base upon which educators depend. Data compilation, data manipulation and its interpretation and simple to complex signal transmission/reception capabilities resulted in previously unimaginable arrays of information, available virtually for the asking. Information itself is a priceless commodity; the ability to utilize that information is as much a survival skill as is the procurement of food. It is no longer enough to simply teach people the facts or fixed procedures. In these contemporary times, it is as critical to provide people with strategies to manage continual changes coming from increasing amounts of information as well as to deal with the changes in the technologies through which information is delivered. Interestingly, the very technologies which have changed the way that we deal with information may hold part of the solution to the dilemma that they pose. However, it is essential that we provide people with the means through which they can make efficient, transparent use of the technologies. Users need to understand that enhanced technological proficiencies will allow them to make use of technologies as tools, through which information access will be considerably improved.

It is essential that distance educators — subject matter experts in the subjects that they teach — should be provided with strategies to integrate contemporary technologies of instructional delivery within existing instructional paradigms which are appropriate for use with their intended audiences. In other words, one should be able to make use of instructional design and development methodologies as a means of instructional contingency management, within which one could then make responsible, appropriate media selection decisions as a component of the design process. By placing media selection concerns within the context of an instructional design framework, we are more likely to see the technologies of information transmission serve as the means to an end of better informational as well as instructional access, whether they are used in traditional or distant educational applications.

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Appendix B

Feasibility Study for a Two-way Interactive Television System

Will Kitchen
Edina, MN

Q. What is a "Feasibility Study" and why should our schools invest in one?

A. A Feasibility Study is usually requested by an individual entity or group intending to explore the "realities" of adopting a new product or process. This document outlines the reasons for and the parameters of a technical and educational Feasibility Study for your schools, regarding the creation of a two-way interactive television network.

Q. What is the role of the consultant?

A. Consultants are often engaged to explore, define, and discuss the steps in the development process. The Feasibility Study for any cluster of schools is comprised of technical and educational information needed by the school districts to permit progress in developing the interconnect project.

Q. What are the components of the Feasibility Study?

A. The contents of every Feasibility Study vary somewhat, due to the very individual natures of the schools involved. Some common elements are:

Program:
Why do schools invest in Two-Way Interactive Television as an instructional medium?

Process:
How do schools go about acquiring a two-way system?

Product:
What do schools get from a Feasibility Study?

One of the first issues school districts must address when considering the adoption of **two-way interactive television (ITV)** relates to the rationale for integration of ITV. Why should schools enter into a cooperative arrangement using ITV? Reasons vary among school districts nationwide, but include:

- Sharing of a wide range of *elective and advanced placement* curricular offerings
- Greater access for teachers and students to *information and training* opportunities
- Ability to link teachers in district schools with each other and with other *sources of information in the region* (often community colleges and universities)

- *Increasing inservice and training* activities for staff, such as peer teacher meetings after school and informal information exchange sessions, by eliminating travel time and expenses

- *Expanding programs and courses* as well as integrating other technologies (facsimile machines, satellite downlinking, computer interconnects, etc.)

- *Increasing innovative outreach programs* for adult and community education classes, prerequisite and college credit courses for advanced high school students, and other uses for local organizations

Process:

While the technologies involved in the creation of an interactive network are fairly simple as a rule, the technique of combining those "hard" technologies — computers, television, audio, and all the components that interconnect the system — is not so simple. The complexities of that process involve many levels of planning, organization, and negotiations that may be beyond the experience of most school-based staff, no matter how interested and committed they are.

Elements inherent in the Planning Process include:

Commitment and involvement at the school level.
All schools involved in planning an interactive project should be active participants in the development of policy and direction for that network. Two-way interactive television is truly a "people-oriented" technology — only as effective as the persons who run it.

Understanding and involvement of staff.
All of the physical changes and upheavals caused by integration of two-way interactive systems are usually off-set by the positive nature of the new relationship between teachers and technology. Teachers are the "software" for this technology application.

With proper "programming" (better known as specialized, hands-on training and support), that software can be customized to fit the exact needs of local schools — and will perform with the zeal and imagination that only a teacher dedicated to the students and ideals of your local school system can do. If teachers are informed and involved during the planning and development of a two-way interconnect, the resultant programming for the system will reflect that careful planning and commitment.

Product:

What will the completed Feasibility Study report consist of?

The **Educational Section** will consist of information regarding the rationale, organization, governance structures, and management of the interactive system. Specific information about educational strategies and assessment will be provided along with staffing and curriculum coordination recommendations.

The **Technical Section** will consist of a resource assessment which concentrates on existing technical partners - like cable TV or other businesses - and other organizational and developmental aspects of the interconnect. The report will identify prospective local business partners, and will contain technical design options, along with projected approximate costs for the proposed interconnect.

In addition:
Timelines for planning and construction of any acceptable network will be rendered for the districts. Other services offered by the consultant may include assistance with the construction of the network, informational presentations, grants and other funding assistance identification and application, teacher/staff training, and many other supplemental actions involved in completing a two-way interactive network.

Appendix C

An abstract

"Audiographic Conferencing in Small Rural Schools in New York State: A Model for Developing Shared Teleconferenced Services Between Rural School Districts"

Denis J. Martin
Project Coordinator
Board of Cooperative Educational Services
Norwich, New York

As a result of geographic isolation, declining enrollments, and eroding local taxes, six school districts chose teleconferencing as an alternative to improve their educational opportunities. The system uses an Optel Telerwiter II-PC, IBM PC, Plantronic PhoneBeam speaker phones with infrared remote microphones, electronic tablet, specialized software, and VoiceToo modem and can simultaneously transmit voice and data on one standard telephone line.

A community advisory group developed goals and objectives. The short-term goals were "to assess and implement ways to strengthen rural education using available technology" through a needs assessment and evaluation process. The criteria for selection of a technology system were cost-effectiveness, delivery capabilities, flexibility, ease of operation, administration, and compatibility. The Optel system was chosen because of its ease of set-up and operation and its interactive capabilities. The long-term goals include establishing an electronic network, assessing administrative applications and post-secondary offerings, involving community organizations and agencies, and encouraging research.

Decisions on curriculum selection, sites, training, publicity, and evaluation plus criteria for evaluation also were part of the process. The first course taught on the system was advanced calculus, which was a "challenging year-long course," had a nationally-administered standardized test, and attracted relatively few students in each site. Class material was mailed, offices were established, and the class met as a group before the first session began. Overall, the "proficiency of the class rated high."

The Optel's advantages were listed as low start-up costs, low risk factor, versatile equipment, easy installation, and little training required for use. Also, Optel provides high quality voice and data transmission, is adaptable for material presentation, and can be moved. Its major benefit is that now teacher/staff resources are shared and the number of educational offerings is increased.

Minis'ry of Education, Ontario
Information Services & Resources Unit,
13th Floor, Mowat Block, Queen's Park,
Toronto M7A 1L2

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